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Applicant(s): Jeffrey Remillard et al. Confirmation No.: 9756

Serial No: 10/065,579 Group Art Unit: 2878

Filed: 10/31/2002 Examiner: Sohn, Seung C.

Title: SYSTEM AND METHOD FOR DETERMINING A DISTANCE OF AN OBJECT USING EMITTED LIGHT PULSES

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APPEAL BRIEF UNDER 37 C.F.R. §41.37

Applicants submit this Appeal Brief in support of the Notice of Appeal filed November 10, 2004 appealing the final rejection of claims 1-26 for consideration by the Board of Patent Appeals and Interferences and request the final rejection of claims 1-26 be reversed and this case be remanded with instructions for passing to issuance.

(i) REAL PARTY IN INTEREST

The real party in interest for this application is the assignee, Ford Global Technologies, Inc., a Delaware limited liability company and wholly owned subsidiary of Ford Motor Company.

(ii) RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings known to appellant or the assignee that are related to, may directly affect, may be directly affected by, or may have a bearing on the

Board's decision in the pending appeal. However, as stated in the specification, Applicants note that this application is a continuation-in-part and claims priority from U.S. Patent No. 6,429,429. Furthermore, this application is related to co-pending and commonly owned U.S. Application S/N 10/065,576, which is also a continuation-in-part and claims priority from U.S. Patent No. 6,429,429.

(iii) STATUS OF CLAIMS

Claims 1-26 are currently pending in this application and have been rejected by the Examiner in the final Office Action mailed August 10, 2004. The rejection of all claims, 1-26, is being appealed.

(iv) STATUS OF AMENDMENTS

No amendment has been filed subsequent to the final rejection mailed August 10, 2004.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

Applicants' claimed invention as claimed in independent claims 1, 7, 10, 18, and 21 uses light pulses reflected from a polymeric light reflector 16 illustrated in Figs. 1-5 and described in paragraph 33, for example, to determine a distance to an object disposed in an environment. As described in paragraphs 4 and 6 of the specification, prior art systems and methods used an infrared laser having a narrow beam path or a laser combined with relatively large reflectors, to provide similar distance detection apparatus. As described in paragraph 11, for example, the use of a polymeric light reflector 16 as disclosed in the systems and methods claimed by Applicants provides a wider beam path that can illuminate a roadway for vehicle applications and that can be packaged in a relatively small package space since the polymeric light reflector is thin compared with conventional reflectors and lenses.

Independent claims 1 (method) 10 (system) and 18 (article of manufacture) all include a polymeric reflector as described above. As illustrated in Figure 1 and described in paragraphs 27-33, for example, the invention transmits a light pulse at a first time from a source 14 to a polymeric reflector 16 that expands and reflects the light pulse toward an object 26. A portion of light reflected from object 26 is received through filter 17, focusing lens 18, and detector 19 which generates a corresponding signal at a second time. An object is detected based on the signal as illustrated in Figs. 7-12 using a detection threshold $V_{THRESH1}$ that decreases with elapsed time as described in paragraphs 50-56, or a constant detection threshold $V_{THRESH2}$ and a gain G that increases with elapsed time as described in

paragraphs 57-63. Distance to object 26 is determined by controller 20 based on a time difference between the first (transmit) and second (receive) times as described in paragraphs 64-66, for example.

Independent claim 7 includes transmitting a plurality of light pulses and reflecting them to an object using a polymeric reflector, receiving the light pulses reflected from an object, and determining an average travel time of the plurality of pulses to determine distance to the object as illustrated in Figs. 10-12 and 14 and described in paragraphs 71-76.

Independent claim 21 includes transmitting a plurality of light pulses to a polymeric reflector that directs light to illuminate the environment, and detecting an object in the environment based on elapsed time from transmitting the light and the intensity of the reflected light with the distance to the object determined based on a time difference between transmitting the light pulses and detecting the object as described in paragraphs 50-66 and 72-76.

(vi) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-26 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Burns (US 5,953,110) in view of Marinelli et al. (US 5,890,796).

(vii) ARGUMENT

The Examiner has not made a prima facie case of obviousness in rejecting claims 1-26 under 35 U.S.C. §103(a). There is no motivation, teaching, or suggestion to combine the references as proposed by the Examiner in rejecting the claims in that neither reference recognizes the problems identified by Applicants and solved by the claimed invention. Even if the proposed combination is proper, the resulting system and method fail to teach or suggest various features of the invention as claimed by Applicants. In addition, the Burns '110 and Marinelli et al. '796 prior art references relied upon in rejecting all of Applicants' claims are non-analogous art and the combination is improper. As such, Applicants respectfully request that the rejection of claims 1-26 be reversed.

1. No Prima Facie Showing of Obviousness

The Examiner has failed to make a prima facie showing of obvious in combining the primary reference, US 5,953,110 (Burns '110), with the secondary reference, US 5,890,796 (Marinelli et al. '796). First, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the disclosure of Burns '110 with those of Marinelli et al. '796 without impermissible use of the teachings of Applicants' disclosure with respect to claims 1-26. Second, the Examiner has not identified a reasonable expectation

of success of the proposed combination with respect to claims 1-26. Finally, the proposed combination of Burns '110 and Marinelli et al. '796 fails to teach or suggest all the claim limitations of rejected claims 7-9, 19 (including average travel time), claims 3-5 and 15-17 (including a decreasing threshold, or increasing gain) claim 20 (including reflecting light pulse to illuminate a width of a roadway), claim 21 (including detection based on elapsed time and intensity), claims 22-23 (including a decreasing threshold) and claims 24-26 (including an increasing gain, average travel time) as described in greater detail below.

1(A). No Motivation to Combine **(Claims 1-26)**. **While the Examiner recognizes that Burns '110 does not disclose a polymeric reflector as disclosed and claimed by Applicants, Burns also does not disclose reflecting a light pulse from any type of reflector (claim 1) or reflecting the light pulse from a first reflective surface in the reflector to a second surface in the reflector and outwardly from the second surface (claim 2). There is no disclosure in Burns '110 of the structure or function of the "laser optics" represented by a single block 13 in Figure 1. The only disclosure of the structure or function of the laser optics is that laser transmitter 12 generates a laser pulse in the laser optics 13 which produces a laser beam 14 directed towards a target 15 (Col. 1, ll. 12-14). This is similar to the prior art described by Applicants (US 5,669,174) in paragraph 4 of the specification which "utilizes an infrared laser to emit pulses of infrared light along a narrow beam path toward an object." As explained by Applicants in paragraph 5 of the specification:**

> The known system, however, has a substantial drawback. In particular, because the infrared laser emits a beam of light along a narrow beam path, automatically detecting objects over a relatively wide area is not possible. For example, if the known system were mounted in an automotive vehicle, objects in front of an automotive vehicle on a roadway that are outside of the narrow beam path would not be detected and thus their distance could not be calculated.

Applicants' invention as disclosed and claimed provides systems and methods that represent a significant improvement over such conventional systems and methods by using a polymeric light reflector that is extremely thin as compared with conventional reflectors and lenses and provides a wider beam path as compared to a narrow beam path transmitted directly from a laser. Applicants' invention can illuminate a roadway for automatically determining distance of objects on the roadway and may be located in a variety of locations due to small packaging as described in paragraph 11.

The Examiner has combined features disclosed by Marinelli et al. (US 5,890,796) to meet these claim limitations. In the first Office Action, the Examiner claimed that it would have been obvious to one of ordinary skill in the art to combine such features "for the purpose of directing equal intensity of light." There is no support in either reference for this rationale. In the second Office Action, the Examiner states that it "would have been obvious to a person having ordinary skill in the art to provide the polymeric light reflector of Marinelli et al. in the device of Burns for the purpose of changing directions of light with not-so-easily breaking polymeric material." Again, there is no support in either reference or in Applicants' identification of the problem for this rationale. Burns '110 simply does not recognize the problems of prior art devices for detecting distance to an object as recognized by Applicants, i.e. having a narrow beam or requiring relatively large optical elements to provide a desired beam, and does not include any teaching or suggestion of a solution. Similarly, there is no teaching or suggestion in Marinelli et al., which is directed to a laser illuminated lighting system, to use a polymeric reflector in a system or method for determining a distance to an object. Therefore, there is no motivation for one of ordinary skill in the art to combine the teachings of Burns with those of Marinelli et al. as proposed by the Examiner in rejecting claims 1-26.

<u>1(B). Non-Analogous Prior Art (Claims 1-26)</u>. Burns '110 and Marinelli et al. '796 are non-analogous prior art and the combination of these references is improper. While the Examiner correctly noted that a prior art reference is analogous if the reference is in the field of applicant's endeavor or, if not, the reference is reasonably pertinent to the particular problem with which the inventor was concerned, the Examiner has not indicated under which test the references relied upon are analogous, or supported either test with any objective evidence.

As stated by Applicants in the response to the first Office Action, Marinelli et al. '796 is directed to a laser illuminated lighting system and is non-analogous art such that the proposed combination is improper. Burns '110 is classified in a different U.S. and International classification than Marinelli et al. '796, and the two references combined by the Examiner do not even have a single common classification in their fields of search. This is objective evidence that the Marinelli et al. '796 reference is not in the field of applicants' endeavor.

As described above, Burns'110 includes conventional laser optics and does not recognize any problem associated with packaging size as recognized by Applicants so there is no teaching, suggestion, or motivation to replace or modify those components to reduce package size. Similarly, there is no teaching, suggestion, or motivation in Marinelli et al. '796 to apply the unitary thin sheet optic used for a lighting system to a system or method for determining distance of an object, absent impermissible use of hindsight based on Applicants' disclosure. As such, the Marinelli et al. reference is not reasonably pertinent to the particular problems with which Applicants were concerned.

1(C). No Reasonable Expection of Success **(Claims 1-26)**. The Examiner has not identified a reasonable expectation of success for using the polymeric reflector of the laser illumination system disclosed by Marinelli et al. '796 in a system or method for determining distance of an object as disclosed and claimed by Applicants in claims 1-26.

1(D). Proposed Combination Doesn't Teach or Suggest All Claim Limitations. Even if the proposed combination were proper, the combination fails to teach or suggest a number of features of Applicants' claimed invention. As described in greater detail below with respect to various claims grouped by feature, the proposed combination fails to teach or suggest the use of average travel time to determine distance of the object, a decreasing threshold based on elapsed time from transmission for detecting the object, a constant threshold with an increasing gain applied to the received signal to detect the object, or detection of an object based on elapsed time and intensity.

1(D)(i). Detection of Object Using Decreasing Threshold **(Claims 4, 16, 22, 23)**. The present invention provides for detection of the object using one of two alternative methods as described in paragraphs 50-63, for example. As explained in paragraph 56 of the specification, this increases sensitivity to allow detection of relatively distant objects that have a smaller amplitude reflection signal at some elapsed time after transmission while decreasing sensitivity to fog or other environmental factors that may cause a relatively high amplitude reflection shortly after transmission. Each of dependent claims 4, 16, 22, and 23 recite variations of comparing the signal generated in response to the received reflection from the object to a threshold that decreases in some fashion as elapsed time increases, or varies based on elapsed time. The proposed combination fails to teach or suggest any such method for detecting an object or subsequently determining distance to a detected object based on elapsed time as disclosed and claimed.

1(D)(ii). Detection of Object Using Constant Threshold and Increasing Gain **(Claims 5, 17, 21, 24)**. As described immediately above in section 1(D)(ii), the present invention provides for alternative ways of detecting an object to detect objects at a distance yet improve performance in fog, for example. As claimed in dependent claims 5, 17, 21, and 24, the present invention includes a gain or similar multiplier that increases as elapsed time from transmission increases and compares the resulting signal to a constant threshold as illustrated in Figs. 9 and 12, for example, to detect the object. Once detected, the distance to the object is determined based on the elapsed travel time, or an average travel time. There is no suggestion or teaching in the proposed combination of Burns '110 and Marinelli et al. '796 to provide such a feature as disclosed and claimed by Applicants.

1(D)(iii). Determination of Distance Using Average Travel Time **(Claims 8 and 25)**. In the Final Rejection, the Examiner stated that averaging received waveforms is a common way to obviate extreme waveform fluctuations, apparently acknowledging that the proposed combination fails to explicitly teach or suggest determination of distance to an object based on an average travel time. While Applicants' claims 7, 8, 19, and 25 recite variations of using an average travel time to determine object distance, dependent claim 8 further requires determination of an average travel time by generating a plurality of received waveforms, aligning the waveforms in a common time interval, and determining an averaged waveform to calculate the average travel time based on the averaged waveform. The average travel time is then used as recited in claim 7 to determine a distance of the object. As recognized by the Examiner, this feature is neither disclosed nor suggested by the proposed combination.

(viii) CLAIMS APPENDIX

1. (Previously Presented) A method for determining a distance to an object disposed in an environment, comprising:

transmitting a light pulse to a polymeric light reflector at a first time;

reflecting said light pulse from said reflector;

receiving a portion of said light pulse reflected from said object, said portion being received at a second time; and,

determining a distance of said object based on a time difference between said first and second times.

2. (Original) The method of claim 1 wherein said reflecting step includes:

reflecting said light pulse from a first reflective surface in said reflector to a second reflective surface in said reflector; and,

reflecting said light pulse outwardly from said second reflective surface.

3. (Previously Presented) The method of claim 1 wherein said determining step includes:

generating a received waveform based on said received light pulse;

indicating the object is detected when any portion of said waveform has an amplitude greater than a predetermined threshold at said second time; and,

calculating said distance based on said time difference between said first and second times.

4. (Original) The method of claim 3 wherein said predetermined threshold has a first value at a first elapsed time after said transmission and a second value at a second elapsed time, said second elapsed time being after said first elapsed time, said second value being less than said first value.

5. (Previously Presented) The method of claim 1 wherein said determining step includes:

generating a received waveform based on said received light pulse;

multiplying an amplitude of said received waveform by a gain value to obtain a gain adjusted value; and,

indicating said object is detected when said gain adjusted value is greater than a predetermined threshold at said second time; and,

calculating said distance based on said time difference between said first and second times.

6. (Original) The method of claim 1 wherein said light pulse comprises a near-infrared light pulse.

7. (Previously Presented) A method for determining distance from an object, comprising:

transmitting a plurality of light pulses to a polymeric light reflector;

reflecting said light pulses from said reflector;

receiving said light pulses reflected off said object using a light detector;

determining an average travel time of said plurality of pulses; and,

determining a distance of said object based on said average travel time.

8. (Previously Presented) The method of claim 7 wherein said step of determining an average travel time includes:

generating a plurality of received waveforms responsive to said light pulses received by said light detector;

aligning said plurality of received waveforms in a common time interval;

determining an averaged received waveform by averaging said plurality of received waveforms over said common time interval; and,

calculating said average travel time of said light pulses based on said averaged received waveform.

9. (Previously Presented) The method of claim 7 wherein said plurality of light pulses comprises a plurality of near-infrared light pulses.

10. (Previously Presented) A system for determining a distance to an object, comprising:

a light source generating a light pulse at a first time;

a polymeric light reflector receiving said light pulse and reflecting said light pulse;

a light detector configured to receive at least a portion of said light pulse reflected off the object, said portion being received at a second time; and,

a controller operably connected to said light source and said light detector, said controller configured to determine a distance of the object based on a time difference between said first and second times.

11. (Original) The system of claim 10 wherein said light source comprises a near-infrared light source.

12. (Original) The system of claim 10 wherein said polymeric light reflector includes a first and second plurality of reflective facets, said first plurality of reflective facets receiving said light pulse from said light source and reflecting said light pulse to a second plurality of reflective facets that further reflect said light pulse toward the object.

13. (Original) The system of claim 10 wherein said polymeric light reflector includes a transparent portion and a reflective surface, said light pulse moving through said transparent portion to said reflective surface, said surface reflecting said light pulse toward the object.

14. (Original) The system of claim 10 wherein said light detector comprises a near-infrared light detector.

15. (Original) The system of claim 10 wherein said controller is further configured to generate a received waveform based on said received light pulse, said controller being further configured to indicate the object is detected when any portion of said waveform has an amplitude greater than a predetermined threshold at said second time.

16. (Original) The system of claim 15 wherein said predetermined threshold has a first value at a first elapsed time after said transmission and a second value at a second elapsed time, said second elapsed time being after said first elapsed time, said second value being less than said first value.

17. (Original) The system of claim 10 wherein said controller is further configured to generate a received waveform based on said received light pulse, said controller being further configured to multiply an amplitude of said received waveform by a gain value to obtain a gain adjusted value, said controller being further configured to indicate the object is detected when said gain adjusted value is greater than a predetermined threshold at said second time.

18. (Previously Presented) An article of manufacture, comprising:

a computer storage medium having a computer program encoded therein for determining a distance of an object, said computer storage medium comprising:

code for inducing a light source to emit a light pulse at a first time that is reflected by a polymeric light reflector toward an object;

code for storing values indicative of a received portion of said light pulse reflected from the object at a second time; and,

code for calculating a distance of the object from said reflector based on a time difference between said first and second times.

19. (Previously Presented) The method of claim 1 wherein the time difference is an average time difference.

20. (Previously Presented) The method of claim 2 wherein the step of reflecting said light pulse from a first reflective surface includes reflecting said light pulse to illuminate a width of a roadway.

21. (Previously Presented) A method for determining distance to an object disposed in an environment, the method comprising:

transmitting a plurality of light pulses to a polymeric reflector that directs at least a portion of the light pulses to illuminate the environment;

receiving reflected light pulses from the environment;

detecting the object based on elapsed time from transmitting the light pulses and intensity of the reflected light pulses; and

determining distance to the object based on a time difference between transmitting the light pulses and detecting the object.

22. (Previously Presented) The method of claim 21 wherein the step of detecting comprises comparing a waveform based on the received reflected light pulses to a threshold that decreases as elapsed time increases.

23. (Previously Presented) The method of claim 22 wherein the threshold decreases in a stepwise manner.

24. (Previously Presented) The method of claim 21 wherein the step of detecting comprises:

generating a waveform based on the received reflected light pulses and a gain that increases as elapsed time increases; and

comparing the waveform to a constant threshold.

25. (Previously Presented) The method of claim 21 wherein the step of determining distance comprises determining distance based on an average time difference between transmitting the light pulses and detecting the object.

26. (Previously Presented) The method of claim 21 wherein the polymeric reflector comprises a transparent thin sheet optical element.

(ix) EVIDENCE APPENDIX

Appellants rely upon the instant application including the specification, drawings, and claims and the prior art applied by the Examiner in the first and second Office Actions (Burns; US 5,953,110 and Marinelli et al; US 5,890,796).

(x) RELATED PROCEEDINGS APPENDIX

As indicated in section (ii), Applicants are not aware of any proceedings related to this appeal.

SUMMARY

For the reasons above, Applicants respectfully submit that the rejection of claims 1-26 under 35 U.S.C.§103 should be reversed, that all formal and substantive requirements for patentability have been met, and that this case is in condition for allowance, which action is respectfully requested.

An additional fee of $500.00 is believed to be due for filing of this appeal brief for a large entity. Please charge this fee and any other fee deemed necessary, or apply any credit to Deposit Account 06-1510 (Ford Global Technologies, LLC). If there are insufficient funds in this account, please charge the fees to Deposit Account No. 06-1505.

Respectfully submitted,

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